New Resonance Parameter Evaluation of Cl Neutron Cross Sections

Royce O. Sayer, Klaus H. Guber, Luiz C. Leal, Nancy M. Larson

Oak Ridge National Laboratory

Better measurements and evaluations are needed for many elements where the existing evaluations or the underlying nuclear cross section data are not sufficiently accurate for reliable calculation of criticality safety margins. Chlorine is an important element in applications where chlorides are present in significant amounts; for example, polyvinyl chloride pipe is 57% Cl by weight. Deficiencies in the existing ENDF/B-VI data evaluation for Cl led to our resonance parameter evaluation of Cl neutron cross sections in the resolved resonance region with the multilevel Reich-Moore R-matrix formalism. Our evaluation takes advantage of recent high-resolution capture and transmission measurements at the Oak Ridge Electron Linear Accelerator (ORELA) as well as older total cross section measurements at Karlsruhe (KFK) to extend the resolved resonance energy range to 1.2 MeV with much more accurate representation of the data than previous evaluations.

Resonance analyses were carried out with the computer code SAMMY, which utilizes Bayes' method, a generalized least squares technique. Doppler and resolution broadening, multiple scattering corrections, and other effects were taken into account. Analysis of the available ^{35}Cl(n,p)^{35}S cross section data was facilitated by the SAMMY capability to compute charged-particle penetrabilities for the proton exit channel.

Our resonance parameter representation describes the data much better than does ENDF/B-VI, and it should lead to improved criticality safety calculations for systems where Cl is present. In the paper we discuss the cross section data, resonance analysis, results, and parameter uncertainties.

ORNL is managed by UT-Battelle, LLC for the US Department of Energy under Contract No. DE-AC05-00OR22725.

Email: sayerro@ornl.gov